

## SYSTEM AND METHOD FOR MONITORING CONGESTION PAGING

### BACKGROUND OF THE INVENTION

#### Field of Invention

5 The present invention relates generally to mobile communications and, more particularly, to a system and method for monitoring paging signals transmitted from a mobile switch to a cell site for occurrences of congestion.

#### Description of the Background

As mobile telephones have grown from mere voice communications devices to sophisticated appliances for paging, text functions and Internet access, bandwidth management has become a critical function for providing Quality of Service (QoS). A wireless communications network typically includes a mobile switch, a paging area, and a cellular device such as a cellular telephone. The mobile switch manages traffic between cellular users. The paging area includes a plurality of cellular telephone transmitters, or cell sites, that cover a certain geographical area. In operation, the mobile switch directs a page, addressed to a certain cellular device, to the appropriate paging area. A cell site, within the paging area, then broadcasts the page, causing, for example, a cellular phone to ring. In practice, network congestion occurs between the mobile switch and a cell site, due in part to limited bandwidth between the switch and the cell site. Such congestion may cause pages sent from the switch to a targeted cellular device, via the cell site, to be lost. Lost pages cause users of cellular devices, such as cellular phones, to miss calls because the phone fails to ring. Paging congestion, therefore, significantly affects QoS. Additionally, paging congestion can lead to substantial revenue losses for telecommunications service providers that fail to collect for unconnected calls.

A mobile switch may communicate with a cell site over a T-1 line. A T-1 line is a commonly used digital line that bundles 24 channels called DS0s, where each DS0 is capable of transmitting 64 kbps, for an overall transmission rate of 1.5 Mbps. Some wireless communication networks, however, may limit paging communications to just one of the 24 channels in a T-1 line, reserving the other 23 channels for transmitting voice data. The growing popularity of cellular phones has caused the DS0 channel dedicated to paging to operate at or beyond its 64 kbps capacity. New services, such as short messaging service and message waiting indicators on cellular phones, also share the same DS0.

A network diagnostic tool is needed that enables service providers to identify, and even quantify, instances of paging congestion. Such a system needs to provide sufficient flexibility to identify paging congestion problems that exceed certain quantitative thresholds. Such a system also needs to provide a notification system in which certain network operators receive timely alerts when a paging congestion problem occurs. The present invention satisfies this need.

#### SUMMARY OF THE INVENTION

The present invention is directed to systems and methods for monitoring a paging signal from a mobile switch to a cellular transmitter for occurrences of congestion. According to one embodiment, the system comprises a switch; a cell site in communication with the switch, for broadcasting a page received from the switch to a cellular device configured to receive the page; and a monitoring module in communication with the switch for monitoring occurrences of paging congestion between the switch and the cell site.

The present invention may be used, for example, to monitor pages transmitted from the mobile switch but not received by the cell site. In the case of a cellular phone, pages transmitted from the mobile switch cause the receiving cellular phone to ring. Lost pages, however, cause

customers to miss calls. The present invention may be used, for example, as a statistical tool for identifying operational problems that might otherwise go unnoticed. In addition to statistical benefits, the present invention may also be used to notify network operators of paging congestions problems. Finally, the present invention may also be used as a loss of revenue 5 indicator by quantifying the number of lost pages that resulted in, for example, unconnected calls.

These and other benefits of the present invention will be apparent from the detailed description below.

## DESCRIPTION OF THE FIGURES

10 For the present invention to be understood clearly and readily practiced, the present invention will be described in conjunction with the following figure, wherein:

FIG. 1 is a block diagram of a cellular communications system according to one embodiment of the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

15 It is to be understood that the figures and descriptions of the present invention have been simplified to illustrate elements that are relevant for a clear understanding of the present invention while eliminating, for purposes of clarity, other elements. For example, certain system details and modules of certain intelligent platforms are not described herein. Those of ordinary skill in the art will recognize, however, that these and other elements may be desirable in a typical network. A discussion of such elements is not provided because such elements are well 20 known in the art and because they do not facilitate a better understanding of the present invention.

FIG. 1 is a block diagram of a cellular communications system 10 according to one embodiment of the present invention for monitoring paging congestion between a mobile switch and a cell site. The system 10 includes a page-monitoring module 12, a mobile switch 14, a public switched telephone network (PSTN) 16, a cell site 18, and a cellular device 20. The 5 monitoring module 12, as described further hereinbelow, receives reports of missed pages from the mobile switch 14 and outputs a notification 22 to network operators 24, such as by email or page, when the number of missed pages due to paging congestion exceeds a predetermined amount. The mobile switch 14 is the bridge between the PSTN 16 and the cell site 18 that ultimately makes the wireless connection to the user's cellular device 20.

10 The monitoring module 12, which communicates with the paging queue of mobile switch 14, may be implemented on an intelligent platform such as, for example, a computer, such as a workstation or a personal computer, a microprocessor, a network server, or an application specific integrated circuit, using any suitable type of computer instruction. Module 12 may also be implemented as software code to be executed by the system 10 using any suitable computer language such as, for example, microcode, and may be stored in, for example, an electrically 15 erasable programmable read only memory (EEPROM), or can be configured into the logic of the system 10. According to another embodiment, module 12 may be implemented as software code to be executed by the system 10 using any suitable computer language such as, for example, Java, Perl, C or C++ using, for example, conventional or object-oriented techniques. The 20 software code may be stored as a series of instructions or commands on a computer readable medium, such as random access memory (RAM), read only memory (ROM), a magnetic medium such as a hard-drive or a floppy disk, or an optical medium such as CD-ROM. According to one

embodiment, module 12 may be integrated with the hardware or software of the mobile switch 14.

According to one embodiment, the mobile switch 14 may be in communication with the module 12, the PSTN 16, and the cell site 18 via a communications network 25 including, 5 individually or in combination, a wireline network or a wireless network. The communications network may include, for example, individually or in combination, a plain old telephone system (POTS), a public switched telephone network (PSTN), a wireless telephone network, the Internet, an intranet, a LAN, or a WAN, using, for example, packet-switching or circuit switching transmission modes. According to another embodiment, the mobile switch 14 may be part of a mobile switching center (MSC) in communication with the module 12 and the cell site 16.

10  
15  
20

10  
15  
20

5

10

15

20

25

30

35

40

45

50

55

60

65

70

75

80

85

90

95

100

105

110

115

120

125

130

135

140

145

150

155

160

165

170

175

180

185

190

195

200

205

210

215

220

225

230

235

240

245

250

255

260

265

270

275

280

285

290

295

300

305

310

315

320

325

330

335

340

345

350

355

360

365

370

375

380

385

390

395

400

405

410

415

420

425

430

435

440

445

450

455

460

465

470

475

480

485

490

495

500

505

510

515

520

525

530

535

540

545

550

555

560

565

570

575

580

585

590

595

600

605

610

615

620

625

630

635

640

645

650

655

660

665

670

675

680

685

690

695

700

705

710

715

720

725

730

735

740

745

750

755

760

765

770

775

780

785

790

795

800

805

810

815

820

825

830

835

840

845

850

855

860

865

870

875

880

885

890

895

900

905

910

915

920

925

930

935

940

945

950

955

960

965

970

975

980

985

990

995

1000

1005

1010

1015

1020

1025

1030

1035

1040

1045

1050

1055

1060

1065

1070

1075

1080

1085

1090

1095

1100

1105

1110

1115

1120

1125

1130

1135

1140

1145

1150

1155

1160

1165

1170

1175

1180

1185

1190

1195

1200

1205

1210

1215

1220

1225

1230

1235

1240

1245

1250

1255

1260

1265

1270

1275

1280

1285

1290

1295

1300

1305

1310

1315

1320

1325

1330

1335

1340

1345

1350

1355

1360

1365

1370

1375

1380

1385

1390

1395

1400

1405

1410

1415

1420

1425

1430

1435

1440

1445

1450

1455

1460

1465

1470

1475

1480

1485

1490

1495

1500

1505

1510

1515

1520

the number of lost pages reaches a predetermined limit, such as 100 lost pages in one hour.

According to such an embodiment, module 12 may issue notification 22 to the network operators 24, such as by electronic mail or by page, via, for example, a wide area network (WAN) 28. The notification 22 may include, for example, the number of pages lost over some 5 time interval. Notifications may also include information to facilitate troubleshooting, such as the location of paging congestion. The location may be designated by, for example, paging area.

It should be understood that the invention is not limited by the foregoing description of preferred embodiments, but embraces all such alterations, modifications, and variations in accordance with the spirit and scope of the appended claims.